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APPLYING INTERNET BASED 3D VISUALISATION AND PRIORITY GAMES IN PUBLIC CONSULTATION

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ABSTRACT

The County of Northern Jutland had just finalised a public consultation concerning a new connection across Limfjorden, which separates the northernmost part of Jutland, called Vendsyssel, from the mainland of Jutland. The County administration was quite aware of the fact the decision concerning the new Limfjorden connection was very sensitive. Many people have already taken their decision without detailed knowledge about the alternatives. All descriptions and assessments of the project we published on the Internet. The aim was to give all the citizens the best possible background for being involved in the decision-making process. The current paper demonstrates how web-based interactive tools can support the participation of the citizens. The use of 3D geo-visualisation / VR makes it easier to represent spatial information in a way that is more similar to how people observe and perceive them in the real world, minimising the gap between observing and perceiving the real world and a modelled world, and certainly this could facilitate the citizen's role in participatory planning processes. This is confirmed by a questionnaire among the active citizens, which showed that about half of the respondents had tried the 3D visualisation (flight simulator) of the various alternatives. One characteristic of interactive participatory planning is feedback and learning, and therefore the County decided to develop a priority game to support the learning process. However, according to the survey, the Priority game had not so much appeal among the public, because only very few respondents had tried the Priority game, and only two of these found it useful in their own decision-making process.

INTRODUCTION

The Northernmost part of Jutland called Vendsyssel is separated from the mainland Jutland by a long fjord called Limfjorden. The current bridge across Limfjorden was opened in 1933 and in 1986 a new motorway tunnel under Limfjorden more than doubled the transport capacity. Since then there has been a debate on the necessity of a new third connection and where it eventually should be located. The County administration of Northern Jutland was quite aware of the fact the decision concerning the new Limfjorden connection was very sensitive for as well citizens as politicians. Many people have already taken their decision based without detailed knowledge about the various alternatives. Public participation practice is a growing part of spatial and environmental planning, but this can only be achieved if the proponent properly collects (and acts upon) evidence, opinions and perspectives from all the

interested or affected citizens, who are to be fully involved in the decision-making process, and from the earliest possible opportunity. All descriptions and assessments of the project we published on the Internet. The aim was to give all the citizens the best possible background for being involved in the decision-making process. However, besides this the county administration decided to utilise advanced Internet based methods for geo-visualisation as well as interactive decision games.

The aim of the current paper is to demonstrate and analyse how web-based interactive tools can support the participation of the citizens. The use of 3D geo-visualisation / VR makes it easier to represent spatial information in a way that is more similar to how people observe and perceive them in the real world, minimising the gap between observing and perceiving the real world and a modelled world, and certainly this could facilitate the citizen's role in participatory planning processes. Playing games is a kind of decision-making problem with two or more players, and where the outcome for each player may depend on the decisions made by all involved players. One characteristic of interactive participatory planning is feedback and learning, and therefore the County decided to develop a priority game to support the learning process and individual decision-making.

The paper will be divided into 4 parts. After the introduction we will give short overview of theories on interactive participation and PPGIS. The third section presents in detail the Web-based 3D Visualisation tools as well as the Priority Game used in the public consultation concerning the new connection across Limfjorden. Finally, we have some concluding remarks and present you for some ideas for following up activities.

PARTICIPATORY PLANNING

The Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992, Principle 10 (United Nations, 1992a) and Agenda 21 (United Nations, 1992b) both called for increased public participation in environmental decision-making and led to the adoption in Europe of the Aarhus Convention (UN ECE, 1998). Thus participation and interactivity in the process of spatial planning and decision-making will contribute to the democratic legitimacy. Most citizens, private companies and societal organisations wish to be involved and to have direct influence on the stages in and the content of the decision-making process. These policies can be enriched with the local knowledge, morals and values of the local public. Furthermore, interaction with the public will improve the efficiency and build more consensus or public support for certain plans and policies. Project leaders and policy-makers can influence the rising of public support during the process.

Participatory planning processes can have many goals with a variety of communication modes, as well as the decision-making actions taken by stakeholders during such a process. The citizens involved in a planning process may have their own goals based on political, cultural and socio-economic factors that are relevant for them. The overall challenge is to define how to support these processes by making a careful definition of the needs of the intended public. According to Wachowicz (2002) these needs can roughly be divided into three main orientations:

- Decision-Oriented Approach
  The central paradigm in this approach is that planning is a process of choice in a situation of uncertainty. This uncertainty is present in the knowledge of the planning environment. In this case, one is not sure about the physical and socio-economical structure of the environment and its response upon the actions of actors. The goal of planning is mainly to inform actors about future decision-making and make future operational decisions interpretable.
- Action-Oriented Approach
  Inherent in this approach is the assumption, that spatial organisation is the result of actions between numerous actors, and planning is defined as the result of actions between actors, which are part of the socio-spatial system. Their actions need to be compliant to and embedded in the society, and decisions are based upon interactions among actors. This means that the focus of planning is on the analysis of the intentional actions and knowledge of the actors involved in planning
- Search-Oriented Approach
  The aim of planning as search for direction is not directly to prepare for an operational decision given a well-defined problem, but to reveal alternatives and new solutions outside the direct scope of the observed problems. Accordingly interactive spatial planning can be considered as a kind of learning process.

The level at which the public is involved varies with the relevant legislation, and the attitude of the other stakeholders. Often it just means informing the public of a previously, made decision and asking for comments, which may or may not be heeded. Sometimes it means informed consultation. For public participation to be effective at any level, it requires the public to be well informed and kept aware of the possibility of participation. This requires a pro-active approach from the relevant public authorities.

Several typologies - participation ladders - are defined, in which the influence of the participants in the process changes. *Arnstein* (1969) claims, that the involvement of the public in decision-making represents a redistribution of power from the authority to the citizens. She describes the public participation by a 'ladder' with 8 rungs each representing the level of citizen participation. This so-called ladder of public participation has 8 rungs divided into three main groups. The uppermost ladder representing 'citizen power', involves public-authority partnerships in which citizens are in control, or can veto agency decisions.

Based on the Arnstein ladder, *Weideman* and *Femers* (1993) developed a revised ladder of public participation, where the involvement increases with the level of access to information as well as the citizen's rights in the decision-making process. According to Weideman and Femers, the public involvement increases as the authority grant the citizens rights higher in the ladder, which can only be reached by full filling all the requirements of the lower steps in the ladder. In most cases, the public participation is limited to the right to object, but the current and future information and communication technologies will provide opportunities to helping the degree of involvement to move further up in the public participation ladder.

However, we should not forget the users when a public participation process is designed. Although we may have high ambitions for the level of participation, we cannot expect that everyone citizen should be able to evaluate various scenarios or even set up their own alternatives. According to *Jackson* (2001) the following questions are important before setting up the level of participation:

- What is the level of knowledge of a particular issue among stakeholders?

– What is their degree of commitment?

Jackson (2001) describes the various stages of public involvement by taking outset in the citizen's knowledge and commitment. For uninformed people a one-way information process is appropriate. For other people with awareness of the issue but with insufficient "technical" knowledge an educational effort is needed. Citizens with more knowledge may be called upon for consultation or even discussing alternatives. The ultimate level of public participation is collaborative, shared decision-making. This requires first of all an informed and educated public, and next an authority that is ready to delegate or share the power with the community. Besides being a good guideline for identifying appropriate levels of involvement Jackson's description can be used to explain the numerous unsuccessful implementations of the participatory process.

Many opportunities for public participation are laid down in the environmental legal framework and Internet GIS can support and facilitate citizen involvement in environmental planning and decision-making. Public participation GIS has proved to be an effective means to increase community participation in the evaluation process. Based on the level of contents and functionality a PPGIS could have various levels of service representing various levels of citizen involvement and interactivity. But simply designating a GIS effort as PPGIS because a non-technical citizen is involved is unfair to the many efforts of non-GIS public participation that seek to enhance the democratic process. On the other hand, being explicit about the domain within which a particular PPGIS effort falls can enhance the credibility, efficacy, and theoretical foundation of such a project (*Schlossberg* & *Shuford*, 2005).

Peng (2001) provides a framework of an Internet based public participation system and categorises the provided level of service based on the information content and interactivity (figure 1). The level of service in a PPGIS ranges from the lowest level at the upper-left corner to the highest level at the lower-right corner. The lowest level of service only deals with information distribution, whereas the highest level of service offer the citizens a much more active role in building scenarios and suggesting alternatives. Thus there is a clear similarity between Arnstein's ladder of public participation and Peng's framework.

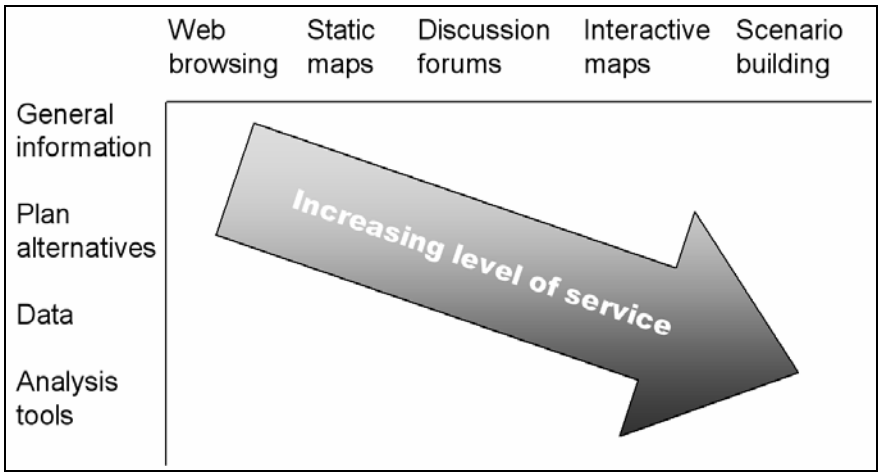

Figure 1: Framework for web-based public participation systems - after Peng (2001).

INTERACTIVE WEB-BASED TOOLS FOR PUBLIC CONSULTATION IN NORTHERN JUTLAND

As mentioned in the introduction the traffic across Limfjorden is to heavy to be facilitated by one bridge and one motorway tunnel. Since then there has been a debate on the necessity of a new third connection and where it eventually should be located.
The proposal for a supplement to the existing region plan included the following alternatives:
A new connection east of Aalborg with a parallel tunnel under Limfjorden

- A bridge over Limfjorden near Lindholm
- A bridge over Limfjorden crossing the island Egholm

Additionally, the last two alternatives were divided into sub-alternatives containing a motorway or an ordinary major road (Northern Jutland County.

Figure 2: The project homepage with the various alternatives for the proposed connection.

The corresponding environmental impact assessment was carried out from September 2002 to March 2003. The result of the EEA as well as an overview of the various alternatives including different scenarios for the general infrastructure development in the Aalborg region was prepared. The description of each alternative contained: a) a short summary of the alternative, b) the total costs, c) traffic load, d) relationships to the general urban development, e) relationships to the surrounding landscape, f) stepwise implementation.

The Northern Jutland County administration was quite aware of the fact the decision concerning the new Limfjorden connection was very sensitive for as well citizens as politicians. Many people have already taken their decision based without detailed knowledge about the various alternatives. All descriptions and assessments of the project we published on the Internet. The aim was to give all the citizens the best possible background for being involved in the decision-making process. However, besides this the county administration

decided to utilise advanced Internet based methods for geo-visualisation as well as interactive games. By a detailed scenario preparation and environmental impact assessment the county administration was very well prepared to a thorough and wide spread public consultation starting in April 2003. It was decided that the decision process should be as open as possible and incorporate the citizens in the final decision.

A specific homepage called www.3.limfjordsforbindelse.dk was established. All comments to the proposals were published on this web-page enabling everybody to follow the other peoples arguing for or against the various proposals. All project scenarios were visualised in 3D including simulated flights along the new proposed connections the Limfjorden. In order to facilitate a qualified discussion a priority-game was furthermore developed. The county administration sat up an Internet based communication system for easy adding comments from the citizens to the County Administration. All comments from the citizens were stored in a database, facilitating search and query requests, and the information was organised into a report, which was added to the home page of the County administration. The database contains 151 comments from a wide spectrum of respondents. Remark, that there is no direct stakeholder identification procedure, and that the system is open to all citizens. As part of the current research we, interviews were performed among all active citizens, and they are defined as citizens who has send written comments to the Web-site. A detailed analysis of the results of this survey can be found elsewhere (*Hansen & Reinau*, 2006).

According to the survey mentioned above, 35 out of 39 respondents agreed that the Internet is a suitable platform for involving the public in decision-making, but 56% of the active citizens would have sent their comments to the County administration even if there had been no Web-site supporting the discussion among the citizens. However, 38% of the respondents wouldn't have done this without the tailor-made Web-page. Thus the Internet seems to play an important role for a broader participation compared with the traditional public meetings. In order to ease the process of handling the comments and suggestions from the citizens, they were encouraged to send e-mail or to use a tailor-made dialog on the project homepage. After completing the consultation phase all contributions from the citizens, NGOs, as well as other authorities were put together and published in a report. Besides this, the County administration has a general Internet based discussion forum called Nordpol, where the citizens can discuss with the officers and even politicians at the County Administration.

Dynamic 3D geo-visualisation

Modern Information and Communication Technology provides several opportunities to create 3D virtual reality representations of the real world. According to Fisher & Unwin (2002) "Virtual Reality is the ability of the user of a constructed view of a limited digitally encoded information domain to change their view in three dimensions causing an update of the view". The use of Virtual Reality makes it easier to represent spatial information in a way that is more similar to how people observe and perceive them in the real world.

Thus the gap between observing and perceiving the real world and a modelled world seems to be reduced by using Virtual Reality, and certainly this could facilitate the citizen's role in participatory planning processes. Interaction with a 3D scene could be done in several ways. Free-movement through a 3D scene like the popular flight simulators gives the most important benefit of Virtual Reality, but this is generally rather demanding concerning navigation skills. Therefore some predefined routes will be necessary in a practical planning context.

As mentioned above the Planning Department of Northern Jutland County decided to utilise 3D geo-visualisation to support the public participation phase. All alternatives were illustrated on orthophoto in order to facilitate the communications of the various alternatives to the citizens. Furthermore the county administration has developed methodologies for 3D viewing on their web site based on Skyline Software (www.skylinesoft.com). After downloading a plug-in from Skyline citizens could see the various alternatives in 3D and even fly over the landscape to get a real visual impression of the effect on the landscape (www.3d.nja.dk). For people not familiar with flight simulator software it could be difficult to navigate over the landscape, and to circumvent this difficulty some predefined flights over the alternatives could be started by just pressing a button from a list. During the flight the user can zoom (change flight height) and get a quite good feeling of particularly the landscape effects of the various proposals.

Figure 3: Snapshot from a virtual flight over one of the proposed connections.

The interview survey showed that about half (46%) of the respondents had tried the 3D visualisation (flight simulator) of the various alternatives, and 55% of the users of the flight simulator found it a useful tool for their own decision. The most frequent reason for not using the 3D visualisation tools was lack of knowledge about this tool (nearly two thirds of the respondents).

Priority game

Finally the county administration developed an Internet based priority game, in order to let the citizens try for themselves the often difficult balancing of various interests against each order. One of the characteristics of interactive participatory planning is feedback and learning. This characteristic makes clear what it's all about in participatory planning: a learning attitude and a very effective way of learning is to play games. Playing games is a kind of decision-making problem with two or more players, and where the outcome for each player may depend on the decisions made by all involved players. The individual player chooses among several alternative actions in order to reach to goal of every game – to win!

The priority game developed by the county administration is a kind of solitaire game with only one player. First the citizens were asked to assign weights to some main parameters and then to evaluate the effect of the various alternatives on each parameter. Based on the weights and priorities a mathematical model tries to find the "optimal" solution. Before the game started the citizens had selected their preferred model. Thus the individual citizens could compare their first intuitive choice with a more analytical based choice incorporating the priorities. The Priority game guides the user through 14 dialogs in a traditional wizard-like user interface. The user has 1000 points, and the aim of the priority game is to distribute these points between the five different proposals. Figure 4 illustrates one of the dialogs, where the user should give weights to various factors – e.g. regional development, traffic, landscape, air, and pollution. The green colour corresponds to 'Very important' whereas the red colour indicates 'Not important at all'. By default the weighting diagram has got the weight 'Important'. During the following 10 steps (dialogs), the user can evaluate how the 5 proposals will affect the 10 factors. The last step (14) illustrates the result of the priorities sat by the user. After having completed the Priority game, the citizens can compare their original – perhaps intuitive – position with the result given by the Priority game.

According to the survey, the Priority game had much less appeal among the public than the 3D visualisation. Thus only 6 out of 39 respondents had tried the Priority game, and only two of these found it useful in their own decision-making process. The main reason for not using the Priority game was lack of information about the possibility as two thirds haven't heard about the priority game. In fairness we must say that the County administration considered the Priority game as an experiment, and therefore it was not advertised broadly, although it was available for everybody at the project web-site. Therefore, it is difficult to make any conclusions concerning the relevance of the Priority game at this stage.

	Meget vigtig	Noget vigtigt	Vigtigt	Mindre vigtigt	Næsten ikke vigtigt	Slet ikke vigtig
Vægtningsfaktor	5	4	3	2	1	0
Regional udvikling	○	○	◉	○	○	○
Trafikafvikling	○	○	◉	○	○	○
Trafiksikkerhed	○	○	◉	○	○	○
Byudvikling	○	○	◉	○	○	○
Bymidten	○	○	◉	○	○	○
Landskab	○	○	◉	○	○	○
Flora-Fauna-Marint miljø	○	○	◉	○	○	○
Luftforurening/støj	○	○	◉	○	○	○
Barriereeffekt	○	○	◉	○	○	○
Sammenhæng exist. veje	○	○	◉	○	○	○

Figure 4: Example dialog from the Priority Game.

CONCLUDING REMARKS

Improved decision-making is perhaps the most promising element in e-Government, and the central idea in all decision-making is how to make the optimum solution and how to get

acceptance by the citizens. Public participation has been an answer to this challenge since the late sixties, and recent advances in GIS and the Internet have improved the technical possibilities for supporting the public participation through PPGIS systems. The current paper has shown how web-based interactive tools can support the participation of the citizens. The use of 3D geo-visualisation / VR makes it easier to represent spatial information in a way that is more similar to how people observe and perceive them in the real world. Thus the gap between observing and perceiving the real world and a modelled world seems to be reduced by using Virtual Reality, and certainly this could facilitate the citizen's role in participatory planning processes. This is confirmed by a questionnaire among the active citizens, which showed that about half (46%) of the respondents had tried the 3D visualisation (flight simulator) of the various alternatives, and 55% of the users of the flight simulator found it a useful tool for their own decision. The most frequent reason for not using the 3D visualisation tools was lack of knowledge about this tool (nearly two thirds of the respondents). Besides this tool the County Administration developed an Internet based priority game, in order to let the citizens try for themselves the often difficult balancing of various interests against each order. One of the characteristics of interactive participatory planning is feedback and learning, and the priority game is one way of supporting the learning process. However, according to the survey, the Priority game had not so much appeal among the public, because only 6 out of 39 respondents had tried the Priority game, and only two of these found it useful in their own decision-making process! The main reason for not using the Priority game was lack of information about the possibility as two thirds haven't heard about the priority game. In fairness we must say that the County administration considered the Priority game as an experiment, but nevertheless games as a concept in participatory planning will be continued and a more advanced version is under development.

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